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The Use of Wood from Urban and Municipal Trees

By Chris Donnelly

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Research Assistant

CT DEEP Division of Forestry

June 2014

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Cover Photo - the bench pictured on the cover photo is on the Broad Street Green in Wethersfield. The above plaque is on the back of the bench. The cover photo and all other photos within the publication have been provided by either Chris Donnelly or Gabriela Doria.

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Preface

This publication is not intended in any way to be a compendium of all that is happening within the State of Connecticut in connection with the use of wood from urban and municipal trees. It would take many more pages and a lot more time to even begin a full report of what is right now a very active area of exploration and interest.

This publication is intended to be a summary of what was learned over the course of several months as Gabriela and I met with tree wardens, sawmill owners, entrepeneurs and others, in order to put together a simple but useful picture of what we saw regarding the use of wood from urban and municipal trees. Throughout, our main focus was on how this might affect tree wardens. We viewed them as our primary but not our only audience.

In our interviews and our visits, we tended to follow the leads that people gave us, tree wardens in particular. Any individuals or companies mentioned in this report are included solely on that basis - because someone mentioned them to us and because we then followed up with an interview. In no way should the inclusion of any company or individual be considered as an endorsement of that company or that person's work. It can be taken, however, as an acknowledgement of their willingness to assist us in our project - and for that, we are thankful.

Acknowledgements

Primary funding for the publication and the work behind it was provided by the USDA Forest Service, Northeastern Area State and Private Forestry. Additional support was provided by the State of Connecticut, through the Regional Greenhouse Gas Initiative and the Department of Energy and Environmental Protection.

Many groups and individuals also contributed in significant ways. Special mention should be given to Christy Hass, City Forester for the City of New Haven, and David Goodson, now with the United Illuminating Company, each of whom had a major role in initiating this study. The assistance of the tree wardens from several towns also deserve mention, including Greg Foran (Glastonbury), Tim Bockus (East Hartford), Walt Veselka (Bristol), Ken Placko (Fairfield), Mark Miller (Danbury), Dave DeNoia (New London), Tom Richardson (Canton) and Bruce Spaman (Greenwich). The time spent by all of the town officials who filled out the survey also is very much appreciated. John Parry and Helene Hochholzer are to be thanked as well, for their patience.

Gabriela Doria as co-author contributed enormously and also deserves special mention. Earlier on, Rachel Holmes established much of the groundwork, through her interviews with tree wardens and her ideas and insights. Charles Liegus of Supreme Forest Products was extraordinarilly generous and helpful. Tom Worthley (UConn), Charlie Liegus (Supreme Forest Products) and Zeb Essyltsyn (City Bench) each took the time to review the manuscript and offer suggestions. Judy Belaval and KC Alexander of DEEP Solid Waste Recycling also contributed. I would like to thank them all.

Respectfully submitted / Chris Donnelly

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Introduction

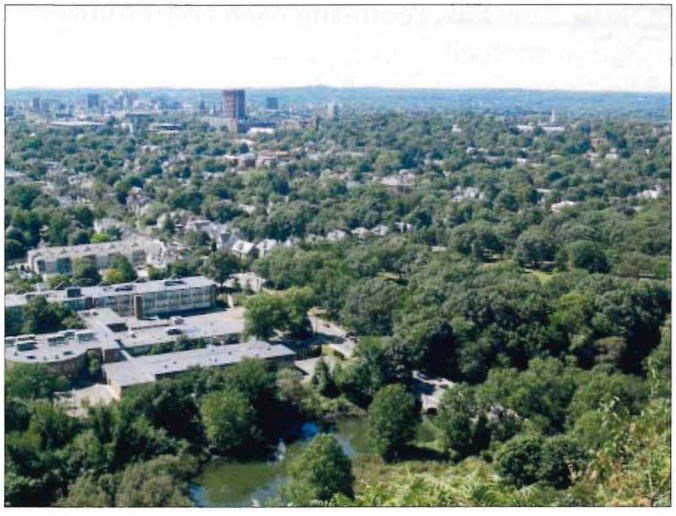
The wood from urban and municipal trees has long been seen as an underutilized resource. While many see this wood as having value, an information gap exists as to the best ways to make use of this wood. As a result, economic value is lost, along with other potential community benefits. Urban wood use could be a component of a good, solid urban forestry program. Instead, the disposal of dead, unsound or unwanted urban trees is often seen as a drain on resources and a cost impediment to achieving other program accomplishments.

As one tree warden put it, "Why is it, in the rural forest, it is not until a tree is cut down that it gains economic value, while in the urban forest, it seems all of the value is in the tree only while it is alive and still standing? Once they are cut down, urban trees are often seen as nothing more than an expense."

The purpose of this report is to explore the current status of the use of urban wood in Connecticut and to suggest some direction as how this wood could be better used. The premise of this report is that this wood is not being used nearly as well or as extensively as it could be. This report will provide some background, examples of current use and an overview of some of the possibilities. It will conclude that more information is needed, along with a greater sharing of ideas and of opportunities, so that urban and municipal wood use becomes an asset to urban forestry programs throughout the state.

Background

Connecticut is a heavily forested state, densely populated and with a strong tradition of home-rule. These three factors all work together to shape how urban wood is currently being used. The state's extensive forests are largely the result of more than 150 years of forest re-growth, following the steady abandonment of agricultural lands that began in the first half of the 19th century. Concurrent with the farm abandonment, Connecticut developed as an industrialized state with its population increasingly concentrated in its cities. Connecticut then become a more suburban state, as people spread back out of the cities and into the abandoned farms where these second and third growth forests were growing. In the process of spreading out, citizens built roads and houses in among the trees, extending the network of roadside forests.



View from the top of East Rock, showing the City of New Haven as an urban forest.

Bristol's Memorial Boulevard, lined with great red oaks.

Elmwood Park, in downtown Danbury. Danbury is one of CT's Tree City USAs.

A nineteenth century house and likely nineteenth century tree in Falls Village.

Meanwhile, in communities throughout the state and especially in the urban centers, there has been a long history of roadside tree planting. Communities such as New Haven, the Elm City, gained a reputation for the extent and quality of their tree-lined streets. There is a connection among trees, public areas and people in Connecticut that is strong, and that has existed for a long time.

Not surprisingly, Connecticut is among the leaders, nationally, in several tree related categories. The state is:

- 56% forested, placing it fifth on the list of most heavily forested states in the country[1]
- Has 73% of its land area under the shade of trees statewide, including forest trees and landscape trees in urban and suburban areas, with 67% of its urban areas shaded by trees[2]
- Is fourth in the country in population density[3]
- Leads the country in the proportion of land area in the wildland / urban interface (72%)[4]

Early on, the Connecticut Legislature recognized the importance of trees, especially those trees alongside the roads in our cities and towns. In 1901, it passed enabling legislation allowing each municipality to appoint a tree warden. In 1918, it amended this law, requiring each community to appoint a tree warden, thus establishing an individual in each city or town who "has care and control" over the trees and shrubs that are in the public right of way, in whole or in part. This law is seen as a judicious combination of the need to safeguard public safety and the need to protect the public's desire for the beauty and benefits of public trees.

The legislature's placing of this responsibility at the municipal level is a manifestation of the deeply rooted and highly prevalent policy in Connecticut of home rule. It is in the Yankee tradition to place the responsibility for domestic policies, such as those that affect home, schools,

continued on page 4

1 The Forests of Southern New England, 2007. Butler et al; published by the US Forest Service, Resource Bulletin NRS -55

2 Urban and Community Forests of New England. Nowak and Greenfield; published by the US Forest Service, General Technical Report NRS-38

3 www.worldatlas.com

4 The Wildland-Urban Interface in the United States, Radeloff et al, Ecological Applications 15(3) pp 799-805

The Environmental Benefits of Using Urban and Municipal Trees

In environmental terms, why is it beneficial to make use of wood from urban and municipal trees? Perhaps the most important reason is that, by helping to at least reduce costs, use of this wood encourages the planting and maintenance of urban and municipal trees. If it is less costly to manage these trees, there may be more of them, in better condition.

The benefits of urban trees are well established, so more trees and better managed trees are important ends in themselves. Trees clean the air, help filter ground water, improve public health, create a sense of place, provide social cohesion – the list goes on. A 2007 study of the trees within the City of Hartford[1] provides some interesting numbers on the benefits provided by urban trees. That study showed that the trees in Hartford, in aggregate, filter out some 73 tons of air pollutants, and, due to their shading and cooling, reduce the demand for electricity by about 2,400 barrels of oil a year.

In addition to encouraging more urban trees, the use of wood from these trees has two other, more direct benefits. First, this wood provides an alternative to the use of fossil fuels. District Energy in Minnesota reports that the use of wood biomass in its heating and power plant decreased its reliance on coal by 70%[2]. The Hotchkiss School in Salisbury reports that, through its use of wood to heat the campus, it has reduced its carbon footprint by about 35%-45%[3].

There are other environmental benefits in producing lumber and other solid-sawn wood products from this wood. To a moderate extent, use of this wood reduces the pressure on rural forests, giving foresters greater flexibility in the management of these forests. More directly, these wood products extend the length of time that the carbon in the wood remains stored, out of the atmosphere.

Carbon sequestration is often cited as a benefit of urban trees. While it is true that urban trees capture and store a great deal of carbon, the most carbon that can be stored at a single growing site, without additional storage as, say, a wood product, is one tree's worth. Over successive generations, as trees are cut down and the tree is either burned or allowed to decay, all of that carbon in the one tree is returned back to the atmosphere. Thus, even if a new tree grows and recaptures all of the carbon back again, there can never be more carbon captured at that site than what is in one tree. Carbon sequestration is not cumulative over generations of trees.

However, the carbon released from the fossil fuels used by the machinery needed to plant, maintain and remove trees are cumulative at a given planting site. At some point, the amount of carbon used to keep a tree growing at a given planting site will exceed the amount of carbon being stored in the individual tree growing at that site.

This is where solid sawn wood products help. Each wood product made from that tree is an effective increase in the ability of that tree to store carbon. As long as the wood product remains, the carbon remains stored. The city bench, made from a town tree and set on the town green for 50 years, continues the important environmental work of the tree from which it was made, in terms of keeping the carbon that tree removed from the atmosphere out of the atmosphere.

Of course, if that bench also encourages people to spend time outdoors, to breathe clean air and enjoy each other's company, the benefits of that bench extend well beyond a simple accounting of carbon sequestration.

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1 "Hartford's Urban Forest – the Challenge" – available through the urban forestry page of the DEEP Forestry web site: www.ct.gov/deep/forestry.

2 Reported on the City of St. Paul's website: www.stpaul.gov/index.aspx?NID=501

3 See the "Environmental Initiatives" section of the Hotchkiss School website: www.hotchkiss.org.

streets and local services, at the local level. In terms of the use of municipal wood, this means that it is primarily the local tree warden who is the critical figure in determining what happens with this wood.

The Current Situation

Research for this report began with interviews of tree wardens. Tree wardens from a selection of cities and towns were asked how municipal wood was used or disposed of in their communities. These interviews led to the formulation of a written survey, posted online through Survey Monkey[5]. Email invitations were sent to the chief elected officials in all 169 cities and towns in the state, with the request that the link to the survey be forwarded to the individual in the community who would be best able to answer the survey questions. After the survey was underway, a separate, paper mailing was sent to those tree wardens whose towns had not yet participated.

The survey was based on the understanding, generated from the earlier face-to-face interviews, that there are three main products from municipal wood:

- Firewood
- Wood chips
- Logs for potential use as solid-sawn lumber

The survey sought to learn more about how individual municipalities handle the wood from municipal trees, with particular regard to these three products.

Approximately 45% of the municipalities in Connecticut responded to the survey (77 communities). Of the respondents, 71% were tree wardens. In terms of population, the municipalities that responded can be considered as representative of the state. 34% of the respondents are from towns with populations of less than 10,000 people; 47% are from towns with a population of between 10,000 and 30,000 people; 8% are from towns with a population of between 30,000 and 50,000 people; 8% are from towns with a population of between 50,000 and 75,000 people; and 4% are from towns with a population of over 75,000[6]. In Connecticut, smaller towns are the norm.

Those who responded were asked the municipal department or departments with which they are associated. Municipal structure often varies from town to town, and responsibility for trees and for the wood from those trees often extends over more than one department. It is not unusual, for instance, for the tree warden to be in the Department of Parks and Recreation while the handling of wood from municipal trees that have been removed is the responsibility of the Department of Public Works. Also, the tree warden in some towns is not an employee of the town and may even be a volunteer who donates his or her services.

Some of the highlights from this survey:

Municipalities were asked whether, apart from the maintenance of utility infrastructure, contractors or municipal workers do most of the tree removals and pruning work in their community. 18% of the municipalities reported that municipal workers do the majority of the tree removals and 27% reported that municipal workers do the majority of tree pruning. In both cases, the majority of the work is done by either contractors (44% for removals, 34% for pruning)

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5 www.surveymonkey.com

6 In comparison, 43% of the state's municipalities fall into the category of those towns having a population of less than 10,000 people, followed by 39%, 7%, 7% and 4% in each of the next size categories.

or a relatively equal mix of municipal workers and contractors (approximately for 38% removals and 39% for pruning). However, 71% of the respondents indicated that it is the municipality that is responsible for disposing of the wood generated by the tree work.

The municipalities were then asked about their policies regarding use or disposal of wood from municipal trees. No community reported that it has a written plan governing the use or disposal of wood. 33% indicated that it follows well-established procedures. Most of the remaining municipalities (64%) indicated that their approach is more flexible, with decisions based on the needs and opportunities of the moment.

As to whether the storms of recent years or invasive insects such as the emerald ash borer or the Asian longhorned beetle have changed municipal practices regarding wood use, 65% reported that practices have not changed because of the storms, while 71% reported that practices have not changed because of the invasive insects. Of those who answered "yes" to either, most indicated that the changes brought about are not significant. Only a few reported significant change due to storms (3%) or insects (4%).

Firewood

Most (80%) of the municipalities make firewood from municipal trees available in some manner. 44% say they make firewood available informally, such as by leaving wood alongside the road for people to pick up on their own. 31% have a program that is based both on people picking up firewood on their own and the processing of firewood by the municipality. 4% reported just a program of processing firewood by the municipality. Only one community reported using a third party to process firewood.

Of those towns that process firewood, one reported charging for that firewood.

Wood Chips

Nearly three-quarters (73%) of the communities reported making chips available, either to a third party or to the public. 59% of the respondents make chips available to the public, while only 7% make them available solely to a third party. 8% make chips available to a combination of the public and a third party. 81% of those communities that make chips available report that there is no cost associated with removing chips. 16% of those that make chips available report that there is a charge to the municipality for the removal of chips. 3% charge for the removal of wood chips.

71% of the communities report that they make use of a tub grinder, either regularly (37%) or occasionally, such as after a major storm (34%). In their comments, various municipalities reported bringing in a tub grinder for use after the pile of compost or backlog of woody debris begins to exceed storage space. Municipalities were asked if residents are able to dispose of wood from private property through their solid waste program. 75% reported that they provide residents with this opportunity.

Sawlogs

78% of the municipalities reported that they seldom make wood from municipal trees available to sawmills, artisans or others for use as solid sawn wood. 19% report that they occasionally send logs to a sawmill, while 6% report that they work with artisans who convert wood into specialty items such as furniture or works of art. This includes wood from municipally owned woodlands (44%), wood from street trees (76%) and wood from town-owned parks (68%). None reported that they frequently send logs to a sawmill or process sawlogs in-house.

There does appear to be some relationship between the use of wood as sawlogs and population size. For municipalities with less than 10,000 people, 84% seldom make large pieces of wood available as sawlogs or in another form. That number is 76% for communities of between 10,000 and 30,000 people, while for communities greater than 30,000 people, it is 70%. For just those communities with a population of 50,000 or more, the number has dropped to only 57% of the municipalities reporting that they seldom make large wood available.

Wood energy

To the question of whether municipalities use wood from municipal trees for energy, whether for small scale space heating, larger energy uses or to produce electricity, the response was highly uniform – they do not. Only one respondent indicated that they use wood for small scale space heating, and that is to demonstrate traditional heating and cooking activities in a museum building.

Removal of a storm damaged tree in Wethersfield following the 2009 tornado.

Wood debris yard in Stratford, following the 2010 tornado to hit that town.

Firebox, showing burning wood chips, at Geremia Greenhouse in Wallingford.

Logs harvested from the Broad Street Green in Wethersfield.

Summary of the Survey

With the one exception noted, there does not appear that much difference between the approach taken by larger or smaller communities. It also does not appear that municipalities, yet, place much emphasis on the possible monetary value or other potential benefits of wood from urban trees.

Local Examples

To better illustrate what this means at the local level, let us look at a few towns that had representatives interviewed for this report. Glastonbury is a moderately sized town in Hartford County, with a population of about 35,000. Similar to many towns, the responsibility for trees and for municipal wood is divided over two departments. The Department of Parks and Recreation is responsible for the care and maintenance of town grounds, parks, open space and street trees. The town tree warden works within the Department of Parks and Recreation and is responsible for the "care and control" of all public trees, including those along streets. It is the tree warden who is responsible for overseeing the removal of trees and also determining where the wood goes.

The town also has an active leaf composting and recycling of wood waste program managed by the Town's Refuse Disposal Division. Screened and unscreened compost along with wood mulch is made available for public and town use.

Glastonbury is somewhat unique in that it has a firewood processing program, through which it sells cut and dried firewood to residents. This program is through the tree warden's office and is supported by staff from the Highway Division of the Physical Services Department. Hardwood trees that are removed are brought to the Highway Maintenance Facility where wood is cut, split and seasoned. Later, the wood is marketed through the Parks and Recreation office and sold in 1/8 cord lots to residents only.

Boules, or stacked, through-sawn logs, from both public and private trees harvested throughout Connecticut. City Bench uses these wide boards to create furniture that also captures the story of each tree.

A table created by Wethersfield artist Ellen Maurer. Ms. Maurer works closely with the Wethersfield Tree Warden, Phil Smithwick, in searching for trees with the specific characteristics she needs for her projects.

The tree warden also regularly seeks out additional, alternative outlets for the wood generated by public tree removals. Occasionally, larger sawlogs are sent to a sawmill. Residents abutting a right of way tree removal are sometimes allowed to have the wood at no charge, providing they take all the wood and not operate any power equipment on the town's land. In nearly every aspect of wood management, Glastonbury finds the costs are lowest when activities are confined as close to the point source as possible.

Most of the softwood (evergreen) trees are taken to the Town's Bulky Waste facility to be processed into mulch. The Refuse Division contracts with a vendor to process the wood waste using a horizontal tub grinder. Such wood is usually ground twice, which creates a consistently uniform material suitable for use on landscape beds at schools, parks and town facilities. The results are a monetary savings, through the use of mulch produced internally, and reduced emissions, by not having to truck raw materials out of Glastonbury and then finished mulch back into town.

Trees are very important to the Town of Glastonbury, as evidenced by the activities of the town Beautification Committee and the extent of the tree warden's involvement in town events. When asked what he would change with respect to wood from municipal trees, Greg Foran, the tree warden, replied, "better markets." Greg expressed a belief that the management of the urban forest would be improved if the disposal of wood from removed trees could be handled more easily and in a less expensive manner. The development of better markets would increase the tree warden's options and would reduce costs, benefitting other aspects of the community tree program.

Just up the road, East Hartford has a similar program. Tim Bockus, Director of Public Works, is also tree warden and a licensed engineer. East Hartford is one of the 19 cities or towns in Connecticut designated as a Tree City USA by the Arbor Day Foundation. East Hartford has held this distinction for the past 18 years. The population of East Hartford is approximately 51,000 people living in a blend of urban and suburban areas that present a variety of tree challenges.

Under the system used by East Hartford, the Department of Public Works is responsible for the town's street trees, while the Department of Parks and Recreation is responsible for trees in the parks. Through the Department of Public Works, there is a very active wood mulching program that makes this mulch available to residents for free. Previously, the town paid to have wood removed, especially after storm events. Now, the town brings in a tub grinder on a regular basis. As described by Mr. Bockus, the desired mix for tub ground mulch includes bark and wood, with few vines and no decayed wood, and some leaves to finish the process.

Residents may also pay a one-time annual fee of $35 for a bulky waste permit that allows them to drop off wood from their properties. The town has a very good relationship with a third party vendor who accepts the leaves from the town's annual fall curbside pickup, some 30,000 cubic feet annually, for use in mulching.

Bristol, also in Hartford County, has a population of about 60,000 people. The city chips smaller limbs and makes the chips available to residents, and leaves firewood for people to take. The city has begun a pilot program with Hinman Lumber of Burlington, by which the City sends 30-40 logs per year to the sawmill for processing. Bristol has a yard waste program through which residents may subscribe to curbside collection for $85/year or may drop off materials to the Transfer Station with up to 200 lbs. for free per visit. Bristol did a trial with Covanta Energy, testing the use of woodchips as fuel in conjunction with Covanta's waste to energy program.

In the City of New London (New London County, population 27,620), firewood is often left for locals to make use of. Residents may bring yard waste to the solid waste transfer station. New London is one of several municipalities that take advantage of the opportunity to use a tub grinder owned by the Southeastern Connecticut Regional Resource Recovery Authority. SCRRRA moves this tub grinder from town to town at the municipality's request. Most towns request use of the tub grinder when they are in need of reducing the town's accumulation of clean brush. The wood grinding process reduces the brush to mulch for use by the town. New London is one of several municipalities that opts for a "double grind", in which the material is passed through the tub grinder twice, further reducing the material into a finer and more consistent mulch.

Fairfield (Fairfield County, population 59,000) and Danbury (Fairfield County, population 81,000) each have a very straightforward system. Each municipality contracts directly with a mulch producer – Fairfield with Harvest New England[7] and Danbury with Ferris Mulch Products. In each case, the relationship is basically the same. The municipality provides the mulch producer with land rent free, and in exchange is allowed to send all wood from town tree care operations, along with leaves, to the mulch producer. Access to the facility also extends to residents, who may drop off their yard waste at the facility for no charge.

These last two examples are included as proof of the existence of value in wood from urban and municipal trees. In the case of both Fairfield and Danbury, the town not only saves in terms of any potential costs associated with disposal of the wood, it also gains in terms of reduced equipment needs, decreased demand on the time of both field and office staff, and being able to provide an additional benefit to its citizens.

7 Formerly known as GreenCycle

Public Trees Go to Shop Class: A Story from Greenwich High School

In the first half of 2011, the Board of Education in Greenwich sought to remove 121 trees adjacent to Greenwich High School, to make way for a school expansion project involving an auditorium and space for music instruction. As these were town-owned trees, the Board was required to get the permission of the town's tree warden, Bruce Spaman. Bruce agreed to the removal of these trees if the Board agreed to a set of four conditions, including replacement of the trees, design of the parking lot so that trees are an integral part, a guarantee regarding the survival of the replacement trees and the utilization of all timber quality trees for lumber, to be offered for use to the Greenwich High School technology and art classes and/or local artisans and woodworkers.

These trees, which included maple, birch, elm, cherry, spruce, oak and ash, were indeed shipped to a custom sawyer for milling, and then to a dry kiln operator before being returned to the school.

The shop teacher at Greenwich High, David Boljonis, is very happy with the way this project has turned out. As he puts it, the students get it. This wood is not ordinary, and that stokes the students' curiosity. There are several unusual species in the mix and pieces of varying dimensions, giving the students an added opportunity to explore and discover. The classes are quickly picking up on the difference between this wood and that with which they normally work.

Sometimes the experience of discovery is immediate, as with the interesting smell of elmwood that got the whole class talking. Sometimes it is more subtle, as when students make that connection between the wood they are working with and the trees outside their windows. This closing of the loop fits in very well with the educational approach of the high school.

And, at about $4 per board foot, all costs included, using this wood makes economic sense. So, in the end, it is proving to be a win all around.

Fuels for Schools and Beyond

The idea is a simple one, but intriguing. What if, to save money on heating bills, a town was able to convert removed town trees and other readily available sources of wood into fuel that could be used to provide heat and hot water for its schools? Suddenly, expenses become savings and the town has taken yet another step towards energy independence and better environmental practices.

That is basically the idea behind the "Fuels for Schools" program. This program was initiated in Vermont in the 1980's and has since been championed by the USDA Forest Service and is spread across the country. The original program, now called Vermont Fuels for Schools (VFFS), has been an enormous success in the Green Mountain state, with some 30% of the public school students attending a wood heated school.[1] Today, VFFS is a collaboration involving the Biomass Energy Resource Center (BERC – a non-profit based in Burlington, VT), the Vermont Superintendents Association's School Energy Management Program (SEMP), and three state agencies: the Vermont Department of Education; the Vermont Department of Public Service; and the Vermont Department of Forests, Parks, and Recreation.

More recent examples include projects in Montana, Pennsylvania, Nevada, Idaho and North Dakota. In each of these situations, as in the case of the Hotchkiss School in Salisbury, CT, there is a close affiliation between the school and the forest products industry that allows the schools to obtain fuel from either forestry operations or forest products production facilities.

The concept of Fuels for Schools is very promising. Indeed, with each new facility built, the technology improves and new challenges are resolved.[2]

To assist with meeting these challenges and help in exploring opportunities, the US Forest Service's Wood Education Resource Center (WERC) has created "The WERC Woody Biomass Technical Assistance Team". Through this team, WERC brings together the expertise of three private firms, the WERC Woody Biomass Coordinator, and key contacts in each State Forester's office to provide targeted technical assistance to facility owners and managers that are considering using wood energy.[3] Currently, this team is offering a prefeasibility study at no cost to those facilities that qualify. Those interested in Connecticut should contact the State Forester in DEEP.

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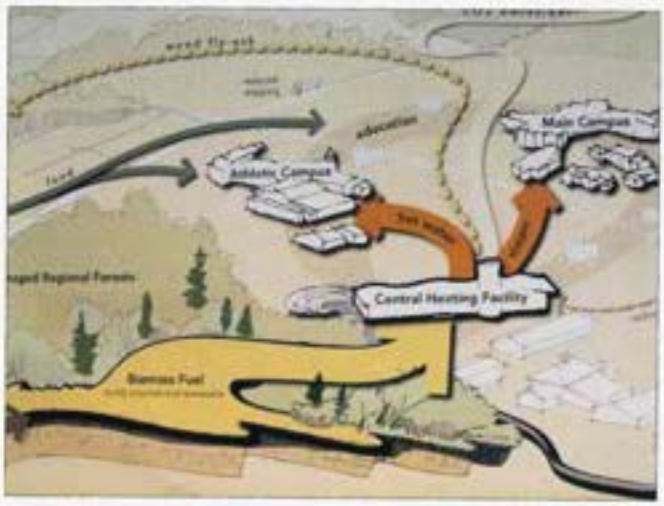
1 http://www.biomasscenter.org/what-we-do/our-programs/state-fuels-for-schools-(green-schools)

2 Fuels for Schools and Beyond, Anduin Kirkbride McElroy, Biomass Magazine. Available on-line.

3 http://www.na.fs.fed.us/ss/11/wood_biomass_tech_assist.pdf



Detail from the display board used by the Hotchkiss School to demonstrate the environmental benefits of using wood chips to meet its need for steam and hot water. The School has taken steps to encourage the educational aspects of this effort. It encourages students to be aware of how their heat is generated and teachers to include the power plant as well as the school's many other environmental initiatives in their classroom work

Opportunities for the Use of Urban Wood

Based on the interviews and the survey, opportunities to make greater use of urban and municipal wood are apparent, but more work needs to be done to encourage this use. Tree wardens and others affiliated with municipalities would benefit from knowing more about how urban and municipal wood could be used. Sawmill operators, mulch producers, arborists, woodworkers and others can help by working with municipalities so that tree wardens and others can gain a better understanding of the possibilities. There will be a learning curve as both those associated with the resource and those more affiliated with the products gain greater insight into how this all might work. This section is an effort to provide some basic information, to assist in that need for better understanding of the potential products.

At this point, it is helpful to note that an overlap exists the potential uses of urban wood and that of wood from small and/or low-quality trees growing in Connecticut's forests. Several initiatives are underway exploring uses and markets for both of these underused resources. In several situations, the potential for the use urban wood is enhanced if it is allied with the potential to use small and/or low quality forest trees.

At the same time, there are distinctions. One such distinction between these two resources is that, without an established market, small and low-quality trees from the forest are not apt to be harvested. Because there is minimal financial incentive, these trees are usually left in place, sometimes to the detriment of long-term forest management planning goals.

On the other hand, the decision to remove municipal trees is often made independent of the potential use of the wood from these trees. Public trees that are not in the right place, are in serious decline or have serious structural issues often must be removed regardless, frequently out of concern for public safety. Even with urban trees on private property, the decision to remove a tree is usually made without much consideration of the potential value to be gained from using the wood from that tree.

This need to remove trees in urban and municipal situations independent of a specific market demand for wood from these trees should assist in the development of outlets for this wood, as the need to dispose of that wood in turn encourages innovation and entrepreneurship. Markets will be explored and better pathways towards utilization of this wood are very likely to develop, creating new opportunities and new markets.

However, a note of caution should also be expressed. Simply because wood is available does not mean that it will draw the interest of a potential buyer. Typically, buyers are looking for wood that has particular qualities and characteristics. A log buyer will be looking at logs seeking the potential yield of quality lumber from that log while a chip producer will be on the lookout for wood that allows his or her company to manufacture a product that will be acceptable to the ultimate consumer of those chips.

Recognizing the needs of the market is important. In particular, if a tree owner is aware of the potential market interest in a tree before it comes down, that can help with planning for the tree's removal. By speaking with potentially interested buyers, the loss of value that might occur from improper handling of the wood from that tree, such as through the incorrect cutting of a log, can be avoided.

Said another way, it is advantageous for a tree warden to have a basic recognition of which trees might produce logs that would be of value to a saw mill, and which trees are best chipped into

the raw material for mulch or for compost. Basic knowledge as to the potential uses of a tree and its wood is valuable. Communication with those who are potential buyers of this wood is also helpful. The key to successful use of urban wood in a community likely will depend upon this knowledge and this communication.

Wood as Fuel

One promising area for the use of urban and municipal trees is the potential to use this resource to generate energy in commercial and institutional settings. Historically, lumber manufacturers have long used scrap wood as a heat source for dry kilns. More recently, schools in several states have converted from traditional fossil fuel systems to the the use of wood chips to provide building heat and hot water. At present, in Connecticut, one private school is meeting almost of its heating needs through the burning of wood chips, while several greenhouses have turned to woodchips as a source of heat. At least one commercial electrical generating facility has come on line that makes use of wood as its primary source of fuel[8].

The use of wood for fuel is a complex topic and urban and municipal trees are only one contributor to the larger picture. Nonetheless, aided by the advance in burning technologies and greater recognition that wood is an underused fuel, the future for urban wood as a fuel is bright.

To clarify a point – the term "wood" in this context is being used somewhat generically. Often, fuel derived from trees is largely wood but is not only wood. In many instances, this fuel also contains bark and other tree parts, including buds, twigs and leaves. Because of that, a more

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8 The Plainfield Renewable Energy facility is a 37.5 MW electrical generating facility that will use biomass as its fuel. So far, its primary fuel has been clean construction debris. However, many expect that it will begin using forest based chips, including possibly wood from urban trees, as part of its fuel base. For more information, visit: www.enovaenergygroup.com/projects-plainfield.html

The firebox does need tending as wood chips are being burned. Here, one of the operators at the Hotchkiss School moves ash in the bottom of the firebox over towards where it can be aggregated and then removed through the use of a screw auger (left of the picture). The ash will be used as a soil amendment.

The central heating facility at Hotchkiss School. Seen in the picture is the building's green roof, one of many environmentally aware design decisions made in the construction of this building, leading it to be one of only 3 power plants nationwide to earn LEED recognition.

By Chris Donnelly and Gabriela Doria, CT DEEP Division of Forestry

Use of Wood Chips for Fuel: Two Connecticut Examples

Joseph Geremia of Geremia Greenhouses in Wallingford is always looking at innovative ways to make his greenhouse facility more efficient and successful. In 2008, a fuel spike prompted him to shift to the use of woody biomass. Instead of using oil, Geremia Greenhouses now uses woodchips to heat water that is piped throughout the seven acre greenhouse facility, allowing plants to grow and people to work.

Local commercial arborists from the nearby area, mostly from the towns of Wallingford and Meriden, provide chips to Geremia at no cost. The greenhouse then uses a tub grinder to make the chips more uniform in size, before allowing them to partially dry before burning.

Geremia burns about 2,000 tons of woodchips yearly. The greenhouse's twin wood boilers are in operation about 9 months of the year. Ash is removed from the stack gases by use of a cyclone system.

Geremia's use of wood for fuel is consistent with the operation's overall progressive approach to business and technology. The company looks world-wide for models to bring home to its CT operation.

The Hotchkiss School in the Lakeville section of Salisbury is a world-renowned independent coeducational boarding school for students of grades 9 through 12. The school has over 600 students living on a campus that extends over 827 acres and includes 85 buildings, 12 of which are dorms, plus a state of the art athletic facility. The demand for heat, to warm rooms and provide hot water, is great.

Appropriate to its role as an educator of young people, Hotchkiss also has a vision for how institutions should use resources while also seeking to protect and maintain environmental quality. When the time came to upgrade the campus heating system, the decision to use woody biomass came naturally.

The school burns approximately 5,400 tons of wood chips in a typical year. This wood is used to produce low pressure steam to provide building heat to the campus and also hot water directly to the athletic facility. The wood chips currently come from two sawmills, so the chips are very clean, without any included bark. The school specifies that its chips come from bole wood rather than tree tops or by means of whole tree harvesting, as the school is seeking to minimize the impacts on forest nutrient cycling. Despite these restrictions, the school has ample access to potential fuel sources.

The school uses two boilers to produce the steam and hot water that it needs. At peak operation, two barrels of ash are generated on a weekly basis. This ash is brought to the school farm where it is incorporated into the soil as an amendment. Emissions are mostly steam, with a few particulates below 0.03 microns. The school uses an electrostatic precipitator that removes about 95% of the particulate matter that would otherwise be in the gaseous emissions stream. A 48 foot tall chimney further disperses emissions into the surrounding winds, reducing ground level impacts to almost zero.

As its educational role is never very far in the background, Hotchkiss works hard to incorporate its use of biomass fuel into the classroom experiences of its students. Besides housing the two wood boilers, the Central Heating Facility also includes a green roof and a rain garden. The building itself has received LEED Silver Certification, a designation which takes into account its use of sustainable building materials such as Forest Steward Council certified lumber and other materials and wheat-based wall boards. The operation of the boiler, including classroom links to the computer control board, is used to demonstrate to students how simple decisions such as room temperature have environmental consequences.

accurate term might be 'biomass fuel derived from trees'. However, to keep things simple, in this section tree derived biomass will be referred to as wood. If the fuel being referenced is 100% wood, without bark or other tree parts included, then that will be noted.

Considerations regarding wood as a fuel

A common characteristic of wood-based fuel is its variability. As suggested, the fuel might in fact be 100% wood, such as wood chips derived from scrap ends during the manufacture of lumber. Or, the chips might contain bark, buds and leaves, such as chips derived from a landscape tree removal operation. To the end user of these chips, these distinctions are often important. For example, while wood is not inherently a better fuel than bark – in fact, bark generally has a higher BTU content – bark can be dirty and difficult to handle. It is stringy and often contaminated with mud and other materials picked up during the hauling of the logs. Some end-users prefer to avoid bark for these reasons. Stumps present similar problems.

There are be other considerations as well. Bole wood, from the trunks of trees, has a higher ratio of wood to bark, making it a cleaner product that some boiler operators will prefer. In addition, bole wood may be specified out of concern for the potential ecological impacts of removing twigs, buds and leaves from the forest. Wood and mature bark tends to be relatively low in mineral nutrients and when these tree parts are removed from the forest, relatively few of these nutrients come along with them. As a result, there is only a minor impact on nutrient recycling. This particular issue is of much less concern in connection with the urban forest, although the quality and variability of the fuel obtained from whole trees is still be a topic for consideration.

The species of trees being used is another topic of interest. In terms of BTU's per dry weight, hardwood and softwood species all tend to be similar. However, when looked at as fuels, softwoods tend to be both less dense and of higher moisture content, and so less heat is produced from softwood chips, either by unit volume or unit weight. This does not mean that softwoods are automatically less effective as a fuel, or that hardwoods and softwoods cannot be mixed together. It does mean, however, that most operators have a preference for hardwoods, particular if hardwoods are more readily available.

That preference often extends down to individual species, with oak cited as a preferred fuel due to its greater density and the resulting higher BTU content per unit measure. However, other factors, such as wood quality, moisture content, price and availability are apt to be of great interest to the user of the wood.

Wood can be used as fuel in the form of whole pieces (firewood), chips, pellets, sawdust and shavings. Whole pieces of wood, such as burned in a fireplace or a wood stove, work well for home heating but have disadvantages when applied on a larger scale. For these applications, wood chips are the main way in which the wood is burned. Occasionally, sawdust and wood shavings are used, but their use tends to be based primarily on ease of access. For large scale commercial applications, pellets – made through the compression of wood through a die – are not often used. The cost of producing pellets reduces one of the major advantages of wood – its relative low-cost as a fuel[9].

In terms of moisture content, surprisingly, wood chips are usually used as a fuel while relatively

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9 For a thorough, and thoroughly useful, discussion of the use of wood chips as a fuel source, see "Wood-Chip Heating Systems: A Guide for Institutional and Commercial Biomass Installations" by Timothy M. Maker and available through the Biomass Energy Resource Center - www.biomasscenter.org

green, often having a moisture content of between 30%-50%. This affects the efficiency of burning, as green chips do not burn as fast as dry chips and the moisture in the wood that goes up the stack as steam is lost heat energy. However, green chips are a much safer fuel in terms of storage and handling. Dry chips could easily ignite outside of the furnace and so are considered as an unnecessary hazard.

Size and source of chips are also important. Chips are best when of a relatively uniform size. Operators tend to prefer chips that are less than an inch in two dimensions and thin in the third dimension. Decayed wood and wood that might include chemical contaminants such as lead paint from demolition debris create problems and are usually avoided.

As noted already, one major advantage of wood as a fuel is that it is relatively inexpensive compared to other fuels. Anything that increases cost, such as transportation factors, will be an important consideration. Currently, the marketplace for the use of wood as fuel is wide open. However, as more operations seek to make use of the advantages of wood's fuel value, this will likely change. Any entity seeking to invest in the commercial use of wood fuel should give careful consideration to what might be the future direction of both wood availability and burning technologies.

The type of equipment and investment needed to burn this fuel

Wood is a complicated fuel, which requires that it be burned in a large space and with a large flame in order for it to be consumed completely. In the typical firebox of a wood furnace or boiler, wood enters, falls on a grate, is ignited as a flow of air is introduced, and is burned. Despite the fact that wood is a complex fuel, the combustion in a modern commercial wood furnace is both efficient and thorough. The gases emitted are cleaned thoroughly of ash particles, the stack gases themselves are very clean and non-polluting and the amount of ash produced generally no more than a small percentage of the initial amount of solid wood. Commercial wood energy facilities can be very good neighbors.

Before being carried to the furnace, chips are drawn from a storage bin and move along a belt. Oversized pieces are sorted out during this stage. This stream of chips is fed into the furnace at a rate controlled by the demand for heat. In a typical boiler, the temperature and rate of flow of the heated water govern the rate at which new chips are fed in to be burned. The control of air flow is also crucial for maintaining temperature and the efficiency of burning. The proper rate of flow of air over the chips helps in burning the chips completely and without excess heat loss up the stack.

In a boiler, the large volume of very hot gases that is generated then passes around a set of heat exchangers – pipes – that contain water. As the water moves through the pipes, it is heated and carried off, to be used for providing building heat or other intended purposes. The now somewhat cooled gases pass up and out through the stack, but not before having any included particulates, including ash, removed from the exhaust gas flow.

Ash is developed in the firebox and must be removed on regular intervals to keep the system operating efficiently. Also, most wood fired boilers have some mechanism such as an electrostatic precipitator by which particulate matter is removed from the gaseous emissions as they travel up the stack. Electrostatic precipitators use electrical charges to trap the fine particulates. As wood fuels tend to be very low in nitrogen, sulfur or many other chemical elements, gaseous emissions from commercial wood fired facilities tend to be largely non-polluting.

The ash itself, collected from both the precipitators and the firebox, is often used as a soil

amendment in agricultural and gardening applications.

While wood chip boilers are the most common type of wood burning device, advances are regularly occurring regarding wood's use both as a fuel and in the types of equipment involved. Wood gasifiers pyrolize wood (heat it in an oxygen limited environment) in order to produce products such as bio-oil and char. In a similar process, wood can be "torrified" – essentially, roasted so as to dry and concentrate much of the fuel in the wood, with the volatile gases that are derived from the roasting of the wood collected and used to provide a large share of the heat energy needed in the process. Wood can also be digested biochemically to release the component hydrocarbons, which in turn have great potential as a fuel source.

All of these technologies are on the horizon, with a anaerobic biomass digestion plant to generate biofuels already being planned for Southington, CT by Supreme Industries. This plant will likely include wood as a raw material at some point. Through these several technologies, wood as a fuel is moving forward. The question is the extent to which wood from urban and municipal sources will be a part of this future.

Wood as Chips, to be used for Compost and Mulch

Wood as Chips, to be used for Compost and Mulch

In a report based on the FY2011 annual municipal recycling data[10], the Connecticut DEEP Solid Waste Program indicated that the municipalities and recycling and/or composting facilities throughout Connecticut collectively kept 270,164 tons of organic material out of the solid waste disposal stream. Of this total, slightly less than one half was leaves. The majority of this organic waste consisted of woody material, including yard waste, wood chips and Christmas trees. This woody material totaled 118,352 tons.

FY2011 (tons)

Brush - Yard Waste	69,943.55
Christmas Trees	190.5
Wood Chips From Yard Waste	1,757.31
Wood from Furniture, Pallets, etc.	56.52
Yard Waste	46,404.08
Total	118,351.96

Cow Manure	679
Food Proc Residuals (Source separated)	5,178.3
Grass	2,263.25
Leaves	143,684.72
Oil Cooking Grease (thru municipal programs)	6.33

While the report did not detail where this organic waste goes, much of it is converted into either

10 For the 2010 report, see Estimates of Connecticut Municipal Solid Waste Generated (MSW), Disposed, and Recycled FY2010, http://www.ct.gov/deep/lib/deep/reduce_reuse_recycle/data/average_state_msw_statistics_fy2010.pdf

mulch or compost[11] and so contributes to the mulch and compost industries in Connecticut. If ever written, the history of organic landscape mulches will be very interesting. Mulch in agricultural applications has been in use for a long time. However, the organic landscape mulches of today are a far cry from the plastic sheeting widely used for row crops beginning in the middle decades of the 20th century.

The increasing use of wood chips and similar organic materials as landscape mulch began in the 1970's. There were a couple of factors that helped spur this growth. The first was improvements in sawmilling technologies. Increasingly, sawmills – especially southern pine sawmills – brought in equipment to debark logs, which led to an accumulation of pine bark as a by-product. The mills soon learned that this material, when ground up, could be used to protect soil and suppress weeds, a fact also picked up on by progressive gardeners. This established a demand for mulch, particularly among landscapers and home gardeners, which became the basis of a growing market.

Meanwhile, the 70's was also the decade in which the recycling movement took off. Wood bark just happened to one of many materials that people sought to find alternative uses for, to reduce the need to send the material to a landfill. The idea was to change the perception of what previously had been considered as useless waste into a material of value.

The CT DEEP was very instrumental in helping develop wood waste recycling in Connecticut, and in helping to establish the basis for the mulch industry.

Today, mulch and compost are well-established as industries in Connecticut. Wood from a variety of sources is ground to produce mulch and compost to a variety and consistency that would make a coffee connoisseur smile. In its least refined form, this material is often called 'chipper mulch', produced from chipped up yard waste and tree parts by a commercial tree care operation. Although heterogeneous in size and source, the 'green' portion of these chips readily supply nutrients to the soil . The bulky nature of these chips allow them to be helpful in reducing soil compaction in high traffic areas. They can also serve as the base for high quality compost.

The more refined mulches require more attention to detail as to source and type of finishing. These include mulches such as pine bark mulch, cedar mulch, hemlock mulch and the many types of dyed mulches, each produced according to popular market preferences. This need for attention to detail can be an advantage to those removing trees who know the preferences of specific buyers.

Perhaps the peak of the market for ground wood used as a mulch or land cover is that associated with playground surfacing. A set of standards exist[12], recognized by the International Play Equipment Manufacturers Association (IPEMA), for 'Engineered Wood Fiber' (EWF). This playground fiber is a highly selected and processed form of wood chip, designed to be used for this purpose. According to the applicable ASTM standards, EWF consists of shredded wood sorted as to size by a series of sieves. As these wood chips must be springy enough to meet the fall attenuation criteria included in the standard and be firm enough to allow wheel chair access, they are usually limited to being from the bole wood of hardwood trees.

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11 Mulch can be distinguished from compost primarily by use, but also by composition. Mulch is applied on the surface of the soil, to help protect the soil. Compost is decomposed organic material. Composted material can be used as mulch, if applied on the surface around a plant, but is considered as compost if worked into the soil. Likewise, organic material intended to be used as mulch can be allowed to become compost, if it is allowed to decompose over time.

12 All are American Society for the Testing of Materials standards. ASTM F1292 establishes standards regarding fall attenuation, ASTM F2075 sets standards for purity and quality and ASTM F1951 relates to accessibility.

The Production of Mulch and Compost

Good examples of the value in urban wood can be found in the Town of Fairfield and the City of Danbury. Each municipality has made an arrangement with a private mulch and compost producer that operates on municipal land rent-free in exchange for allowing the municipality and its residents to drop off any tree and yard waste generated at no cost. Each facility then converts these raw materials into commercially valuable mulch and compost products.

In Fairfield, the company is Harvest New England[1] (formerly GreenCycle); in Danbury it is Ferris Mulch Products[2].

The tree wardens in both communities express a great deal of satisfaction with this arrangement. Mostly, they prefer this system because it simplifies the process of handling the wood generated from routine tree maintenance operations. Previously, each community had a firewood program that they found was time consuming and held a high potential for injuries from the cutting and splitting of the wood. Each facility (Harvest New England and Ferris Mulch Products) were able to work with FEMA following the recent storms, receiving and tracking the volumes of storm generated wood debris.

The operators at each facility make very clear their concern about the quality of the material that they receive. It might seem odd to someone conditioned to think of yard waste and bagged leaves as refuse. However, these individuals pay strict attention that the material they take in is not contaminated with painted wood, metal pieces or, perhaps worst of all, plastic bags. Such contaminants can be very difficult to remove during the mulching and composting processes, and can damage or destroy the quality of the product.

Supreme Forest Products[3] is also a major producer of compost and mulch in Connecticut. Supreme differs in that it receives material from a range of towns. The strength of the markets for each of these three companies as well as their rapidly expanding product lines are testimony to the value to be found in recycling what was once perceived as waste. They also show that the potential for the use of wood, even wood once considered as of low value, continues to grow. These are but three larger examples of the numerous wood mulching facilities that exist around the state.

Adding color to mulch at Ferris Mulch Products. Ferris is located in Danbury.

The array of mulch products on display at Supreme Forest Products' Southington yard.

1 For further details, visit harvestpower.com/ne/fairfield
2 For further details, visit www.ferrismulchproducts.com
3 For further details, visit www.supremeforestproducts.com

The Movement of Wood and the Spread of Invasive Insects and Diseases

It is well-recognized that the movement of wood is a major contributor to the spread of invasive and exotic insects and diseases, including the emerald ash borer, the Asian longhorned beetle, Dutch elm disease, oak wilt and a lengthy list of many more. The potential for the spread of these unwanted organisms is especially great when wood is moved with the bark still on, as with firewood and sawlogs. Please be aware of the latest regulations, quarantines and concerns. Please stay informed.

Details can be found through DEEP Forestry (www.ct.gov/deep/forestry), the CT Agricultural Experiment Station (www.ct.gov/caes) and USDA APHIS (www.aphis.usda.gov).

Sawlogs and Solid-Sawn Wood Products

Sawlogs are another potential product from the urban forest. Generally speaking, sawlogs are large, whole pieces of wood cut from the bole (trunk) of the tree, of sufficient length and cross-sectional diameter to be then converted to other, solid wood products. The most notable item produced from sawlogs is lumber. However, sawlogs can go to other uses, such as being peeled for veneer, hollowed out to produce benches and other custom items, or even used whole for structural purposes. These types of potential uses should not be neglected when considering what to do with an individual log.

Solid sawn lumber is a common and essential commodity item. Uses of solid sawn lumber include structural lumber, such as the timbers and dimensional lumber (e.g. 2x4's) on which wood-frame building construction is based; board lumber used for other, general construction purposes, including high end finish applications; and other lumber products such as those sold to secondary wood processors for further manufacture. For instance, many sawmills produce 'cut-up stock' – boards from which secondary manufactures can cut useful, high quality sections that in turn are used for furniture parts or similar items.

Specialty items and custom sawn wood also belongs on this list, including wood that is used by woodworkers, carpenters, artisans and artists for a wide variety of purposes.

There is a well-established wood products manufacturing industry in Connecticut. The majority of wood sawn in the state is from hardwood species, although a significant amount of softwood lumber is produced[13]. Much of the hardwood lumber then goes on to secondary manufacturing, to become flooring, paneling, furniture and cabinetry. Red oak is the predominant lumber species harvested in Connecticut.

The means by which the primary processing of lumber – the conversion of raw logs into lumber – occurs can be separated into two broad categories. Custom sawmills cut wood according to the wood owners' specifications. Often, custom sawyers do not own the logs that they mill. Instead, they are providing a service for the owner of log, who receives back the wood products requested at the end of manufacturing process. By-products are often then left for the sawmill owner to dispose of as he or she chooses.

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13 In the mid-1980's, approximately one-third of the sawlogs harvested in Connecticut were softwood. Source "The Forests of Connecticut", USDA Forest Service Resource Bulletin NE-160. More recent data from the "Primary Processors Directory March 2013" suggests a ratio of softwood lumber produced in the state as compared to hardwood lumber of approximately 13%. See also the "Certified Forest Practitioner Annual Report Summary 1998 through 2008". These last two publications are available in the publications section of the DEEP Forestry website: www.ct.gov/deep/forestry.

Alternatively, market sawmills buy logs which they then manufacture into lumber for subsequent sale. For most mills, this means producing lumber according to standardized grades that can then be sold as a commodity. For hardwoods that are not going to be used for structural purposes, standard lumber grades are established by the National Hardwood Lumber Association[14]. It is these grades that are the basis of an extensive competitive market that strongly influences how mills determine which products to manufacture.

A key to the success of any mill is how well it is able to make full use of each log. For mills sawing lumber to meet lumber grades, this means being able to successfully predict market demands. For almost every mill, this also means having outlets for low quality material and by-products such as sawdust, cut ends and outer slabs of wood from the bark.

Sawmills themselves can be categorized as either being in a fixed location or being portable. Fixed mills tend to be larger mills with more efficient equipment. In Connecticut, most fixed sawmills cut logs using a circular saw, although some large mills use large bandsaws to saw up logs[15].

Recently, there has been a growing interest in the use of portable bandsaw mills. Such portable mills are not expensive to purchase and are capable of being transported to a location, to mill logs on site. In production terms, these are smaller volume mills, with productive capacity of these mills much less than those of the larger circular or fixed-location bandsaw mills.

With regards to urban trees, these portable bandsaw mills offer one large advantage, however. The saw blades themselves tend to be relatively inexpensive to buy and easy to replace. Hard objects such as pieces of metal encased within the wood are not unusual in logs derived from urban and municipal trees[16]. Metal items such as nails, signs and even horseshoes can do considerable damage to a blade. With a circular saw or a large bandsaw, the costs of repairing or replacing the sawblade and the loss of time and productivity while the saw is shut down is considerable. As a result, many larger, fixed location sawmills simply refuse to saw urban wood. Those that do usually employ metal detectors to scan logs before running them through the mill.

Another type of portable mill that sees some use in Connecticut is the swing blade circular sawmill, or "swing mill". This type of portable mill uses a circular saw blade to cut the wood but is otherwise similar to a portable bandsaw mill in terms of cost and portability. It also has a couple of advantages. It can be used to saw up larger-diameter logs and it edges the boards as a part of the initial cutting process, thus simplifying the cutting process. However, due to a thicker kerf, swing mills lose more wood to sawdust than do portable bandsaw mills. The thin kerf and consequent lower loss of wood is a major advantage of current portable bandsaw mills.

Regardless of the type of mill, the portability and lower costs of a portable saw mill gives the mill operator a great deal of flexibility as to how and why they might want to run their mill. There are portable sawmill operators who custom saw logs, meeting the request of a log owner, and those who buy their own logs, to be sawn according to their choice and need. Portable mills are

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14 Structural lumber, to be used according to standardized building codes, must be graded according to grade rules overseen by the American Lumber Standards Committee (ALSC). The set of ALSC-approved grade rules most commonly used by Connecticut sawmills are those established by NELMA (the Northeast Lumber Manufacturers Association). NELMA also has the responsibility of seeing to it that its rules are properly applied. This usually happens through mill visits and inspections of graded lumber.

15 To learn more about Connecticut's fixed location sawmills, see the "Connecticut Primary Processor Directory" off of the Publications page of the CT DEEP Forestry web page – www.ct.gov/deep/forestry.

16 Such logs are most often termed as "metal-laden". Another term, often applied to pieces of metal that contaminant wood whether the wood is a board, a chip or mulch, is "tramp metal".

A Tale of Two Sawmills

Moore's Sawmill[1] in Bloomfield is an excellent example of a custom sawmill. Dating back to 1875, the mill has been run by more than 5 generations of Moores. As indicated on their website, their sawmill is about producing custom products out of "your logs". While the mill does have specialties, including random width oak flooring, the customer is the one who determines what gets produced from an individual log. Essentially, he or she is paying for a service. As such, this makes a mill such as Moore's a good choice for situations such as restoration carpentry, where lumber of needed dimensions are not otherwise always readily available, or utilitarian situations, where an individual or a town already owns the wood and seeks to use it in house, for perhaps benches or picnic tables.

Moore's sawmill operates a circular saw and saws about 200,000 board feet a year. In addition, the mill's operations include a state-of-the art planing mill and extensive dry kiln capacity, able to dry 75,000 board feet of lumber a year.

One key to Moore's success is its ability to use the by-products from its milling operations. In the process of cutting the boards needed for the customer's order, there are all sorts of 'left-overs' – sawdust, slabs from the outside of the logs and short, random lengths of otherwise useable wood. Moore's Sawmill finds commercial outlets for this material, as animal bedding, firewood and, once shaped by a dedicated machine, tomato stakes. It is this attention to detail and opportunity that keeps the mill in operation.

As many of the logs that Moore's mills comes from municipalities and residential building lots, metal in the wood is always of concern. At Moore's, the sawyers scan each log with handheld metal detectors before placing them on the carriage. They are also very careful to look for signs of metal in the wood, such as the blackish-blue stain often visible in the end-grain of an oak log containing metal.

E. R. Hinman & Sons Sawmill,[2] in the town of Burlington, is also a longstanding Connecticut sawmill, tracing its history back to 1830. In many ways, the type of sawing done at Hinman's is similar to that done at Moore's, as they both include in their customer base the custom wood worker, the timber framer and others needing very specific sizes and lengths of native lumber.

At Hinman's Sawmill, a circular saw is used to produce about 2,500,000 board feet of lumber a year. The sawmill is careful to note that all wood that enters the mills leaves in some useful form. The wood is sawn, edged and often kiln-dried and custom-planed. Certain logs are kept long-length to allow the potential use of the lumber produced in applications where long lengths are needed, such as in timber frame construction. The mill works with a lumber grading agency to grade structural timbers to satisfy building code requirements. Sawdust and wood shavings all go on to become animal bedding. The mill uses a horizontal grinder to produce mulch from the bark stripped from the log before milling.

Although Hinman's does do some custom sawing, most of its production is from logs it has purchased through a network of foresters and forest practitioners. Thus, the key to its success is being able to read the market and have on hand the material needed to be able to produce the products that will be in demand at the time the mill has them ready for sale.

Doing this right depends heavily on knowing logs and what each log is capable of becoming. As the log purchaser has the option to bid or not on any given log or load of logs and works with the seller to determine a price, the purchaser has to know what he or she is looking for. There is a set of criteria regarding log grading that is generally standardized within the industry, but that is flexible enough to allow the individual buyer the ability to make decisions based on his or her mill's needs.

For more information regarding other sawmills in the State of Connecticut, go to the "Connecticut Primary Processor Directory" on the DEEP Forestry website[3].

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1 For further details, go to mooressawmill.com

2 For further details, go to erhinman.com

3 www.ct.gov/deep/lib/deep/forestry/forest_practitioner_certification/primaryprocessors.pdf

Demonstration of portable bandsaw milling and board tallying as part of UConn and DEEP workshop held at White Memorial in Litchfield.

Portable sawmill in action, as part of same workshop. The log being milled was a high value cherry log harvested on the grounds.

Native lumber used for structural purposes. According to the building code, these timbers must be assessed by a recognized grading agency.

Blue-black staining on an oak log, indicating the presence of iron within that log. The sawyer will be careful to avoid this metal if possible.

Black locust cants in a lumber millyard. Black locust is relatively uncommon commercially but is very useful due to its natural decay resistance.

Loading up a tractor-trailer truck with mulch from the Supreme mulch yard in Southington. Large shipments of mulch are now common.

often brought out on-site, to cut locally grown trees. Because of this flexibility, portable sawmills greatly improve the potential for the use of urban and municipal wood.

Wood from a sawmill is usually not considered fully processed until it has been dried. Below about 30% moisture content all wood shrinks or swells with changing moisture content. For a secondary manufacturer, having wood that has not been dried consistently and to an appropriate moisture content can destroy a product run. If not dried properly, sawn wood can cup, warp, check, split or become stained and so lose value. The moisture content of the wood and the drying process itself are of great interest whenever wood is brought to market for further manufacturing. For secondary wood processors, the quality of the drying process is critical.

Another solid wood user group includes those woodworkers, artists and artisans who convert solid pieces of the tree into an amazing array of final products. Among those in this group are those who use large pieces of branch wood to turn bowls, carve art works or otherwise put the wood to use in highly inventive and creative ways. Because, in many cases, the objects they produce are unique and highly valued, the raw material they seek is also often both unique and of great potential value to them. It is important that tree wardens and others not overlook this opportunity for use of urban wood when considering the disposal of urban and municipal trees.

Recommendations

Industrial Clusters

An approach to increasing the use of urban wood is that recommended by Dr. Steven Bratkovich of Dovetail Partners, Inc. It is based on the concept of an 'industrial cluster'. Industrial clusters are "groups of firms and/or organizations located within a defined geographic region who have developed cooperative links with one another through value and supply chains, labor, and use of similar inputs, technology, and complementary products."[17] Other characteristics of an industry clusters include:

- Entrepreneurship
- Innovation
- government support
- the existence of complementary enterprises
- common access to raw materials and markets
- leadership, and
- a commitment to collaboration.

To illustrate this concept, Dr. Bratkovitch uses the St. Paul, MN company "Wood from the Hood". Wood from the Hood is a small, innovative wood-working shop that sits in the middle of an extensive network of other businesses, all involved with wood in some manner (see figure 1). The company succeeds in part because it has several potential suppliers of its raw material - wood milled from urban trees - as well as several varied outlets for the woodworking items it produces.

As described on their website, Wood from the Hood was born from a simple idea: to reclaim discarded trees from urban neighborhoods to create beautiful, high-quality wood products. Though the company is small, their production is varied. Products include flooring, furniture,

17 Using Industrial Clusters to Build an Urban Wood Utilization Program: a Twin Cities Case Study. Prepared by Dovetail Partners, Inc. Available at the Dovetail Partners website: www.dovetailinc.org

lumber and numerous custom items for specific buyers. The receive wood from a tree service firm, but also from a custom sawyer and from others involved in the wood trade in the St. Paul area. The nature of their business requires the company to be nimble and responsive, able to take advantage of opportunities.

This is a trait that they share with other key players in the industrial cluster. For example, the tree care company has several options regarding what it can do with the logs it acquires as a part of performing arboricultural tree work. Not all logs automatically go to Wood from the Hood.

A major driver of this industrial cluster is District Energy. District Energy provides heating services for commercial, residential and industrial buildings in downtown St. Paul and is the largest hot water district heating system in North America. Associated with District Energy is a combined heat and power plant (CHP). Besides heat, the CHP produces 25 megawatts of electricity. It is fueled by clean urban wood and uses approximately 280,000 tons of wood fuel a year.

CHP's large and steady demand for wood serves to draw in many potential wood suppliers. Because of this demand and the steady flow of wood generated, there are more people with more reasons to think in terms of what other uses for which all of this wood might be useful. Having District Energy as part of this industrial cluster provides a very useful framework.

Can something like this work in Connecticut? Very possibly. While Connecticut does not have that single, large, central, wood-consuming entity that St. Paul has, Connecticut has many other key elements that could be brought together to achieve similar results.

For example, the state has a healthy sawmill industry that is diversified and flexible and that could absorb into its supply chain higher value logs from the urban forest. Municipalities could also work directly with smaller, custom sawmills to manufacture needed forest products out of publicly owned trees, or they could purchase a portable sawmill and meet some of their own wood needs directly. The use of wood for energy is growing steadily, with early successes likely to encourage more interest and innovation, which will in turn increase demand and development.

In the case of both solid wood products and heat energy, the potential for use of urban wood is closely linked with existing or developing supply chains from traditional forestry activities. With regards to mulch and compost, the use of urban wood is a success story already in progress. Several large companies throughout the state are already heavily invested in using urban wood as a raw material for a highly-popular end product.

Table and benches created by City Bench out of a removed New Haven street tree. The brass marker at the lower end of the table indicates the address where the tree was growing before removal. The table is located at the Yale Farm, on the Yale campus in New Haven. It is adjacent to a large vegetable garden tended by Yale students as part of the Yale Sustainable Food project. The table and benches are housed in an open air structure framed from Connecticut Grown timbers. Students and others often congregate to share meals and perspectives on issues relating to sustainability and environmental quality.

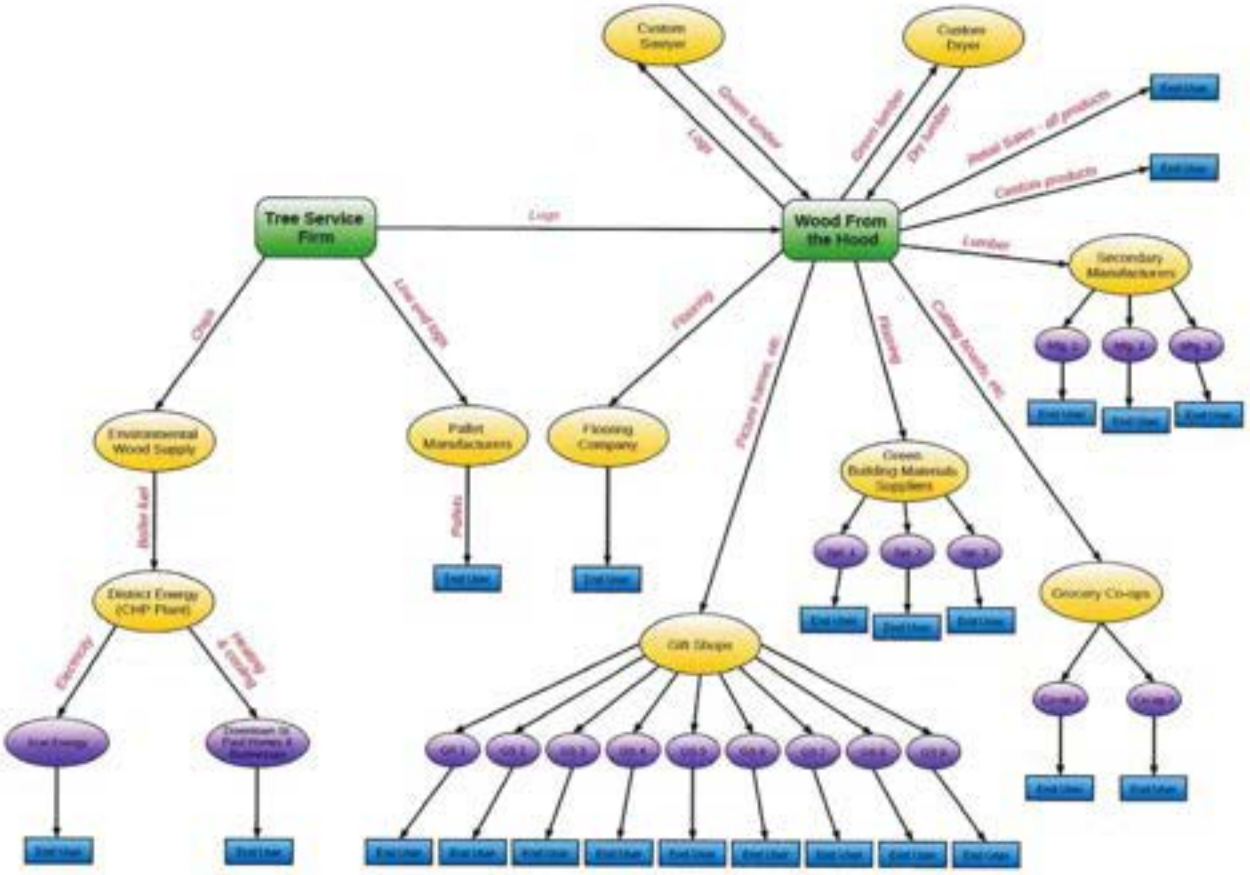

Figure 1 - Industrial Cluster with "Wood from the Hood" in the center. The abbreviations used in the diagram stand for the following: Mfg (Manufacturer), Spl (Supplier), GS (Gift Shop), Co-op (Grocery Coop), End User (Final Customer). Illustration used with permission of Dr. Steven Bratkovich, Dovetail Partners, Inc.

What else would help with developing the use of wood from urban and municipal trees in Connecticut? We offer the following recommendations that might help further the industrial cluster model:

The development of a basic set of standards or specifications for various potential products, such as saw logs, wood chips, mulch and biomass fuel. Tree wardens and other decision-makers need to have a basic understanding of what gives a tree or a volume of wood the potential to be used for various purposes. They should also know what steps they can take to help guide trees towards more complete utilization.

This needs to be based on communications among those who own the trees and those who are the potential buyers or users of these trees and its wood. Already, the Tree Care Industry Association (TCIA) is well along in the development of an ANSI Standard on the assessment of logs from urban trees[18]. Publication is anticipated in either late 2014 or early 2015.

Increased Entrepreneurship. Several of the activities discussed in the previous pages are first-of-a-kind efforts in the state. Their success is an indication that innovation can work, but that also means that someone needs to step up and take the risk. Government entities try and do

18 When finished, the document will be ANSI A300, Part 11. It is expected that the new standard will be open for public review early in the second half of 2014, with full publication to occur after that. TCIA will be the secretary for the document. Details will be available through its website: www.tcia.org.

their part, providing ideas, information and support. In particular, the USDA Forest Service's Wood Education and Resource Center (WERC)[19] is an outstanding resource, with an archive loaded with links, documents and educational webinars that can help anyone quickly come up to speed with respect to opportunities for use of urban wood and other under-utilized forest trees. Connecticut's Department of Energy and Environmental Protection (DEEP)'s Division of Forestry[20] also has many resources to offer through its urban forestry and also its wood utilization programs. The University of Connecticut is very active in promoting research into this field (see separate sidebar). And, of course, there is support for economic development through both Connecticut's Department of Economic Development and Department of Agriculture[21].

Increased Use of the Connecticut-Grown Label. The Connecticut-Grown program, with its readily identifiable label, was begun by the Connecticut Department of Agriculture (DoAG) as a means of promoting awareness of local agriculture. It has been a great success, with agricultural products from meats to vegetables to honey and to fruits all potentially listed. The public has been very responsive to the concept and many agricultural producers have benefitted as a result.

In late 2010, DEEP and DoAG signed a memorandum of understanding, allowing the Connecticut Grown label to be applied to forest products, based on standards developed by the DEEP's Division of Forestry. So far, 19 forest products producers have qualified for the use of this label[22].

The MOU between DEEP and DoAG does allow the Connecticut Grown label to be applied for wood products from the urban forest, providing there is a measure of sustainability associated. The Division of Forestry is currently working on these criteria. Once these criteria are finalized, qualified producers will be encouraged to make full use of this label.

Consider Avoided Costs as Well as Potential Income. While there is economic value in the wood from urban and municipal trees, it is not likely that harvest of these trees will turn into a profit center. However, in terms of creating economic benefits, especially for a local government program, avoided costs can be just as important as net profits. Avoided costs can free up funds for other uses and for improving existing and new programs.

Work to Develop Local Networks. One point that should be clear by now is that, in connection with wood from urban and municipal trees, nothing happens in isolation. Actions can lead to opportunities that can then lead to further actions, with increasing numbers of players involved. This is how networks evolve.

In association with urban wood and municipal trees, local networks are particularly important. This might mean making connections that are not immediately obvious, but that can help lead to that next step, and maybe create a new outlet for the resource.

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19 www.na.fs.fed.us/werc/

20 www.ct.gov/deep/forestry

21 www.ct.gov/decd and www.ct.gov/doag respectively

22 Visit the CT Grown Forest Products page on the DEEP Forestry web site – www.ct.gov/deep/forestry

Research efforts at the University of Connecticut on Local Wood Products[1]

The traditional timber products industry follows a high-volume and high production commodity model. Timber harvesting businesses that participate in this market are heavily invested in expensive, high-speed, high-volume equipment and are unable to address small-area and small volume timber management issues economically. Several social, economic and environmental factors present in CT are creating a need to more pro-actively manage relatively small forested areas and small quantities of trees. These include invasive insect threats, certain wildlife habitat enhancements, and the management of roadside woodlands for storm resiliency[2]. Creative, scale-appropriate methods for management with these issues in mind and utilization of the wood produced are the subjects of several research efforts at UConn in the Department of Natural Resources and the Environment[3] and in Extension[4].

One research project examined attitudes about locally-produced wood in the context of the broader "locally-grown" movement. Positive attitudes offered by opinion leaders indicated that customers perceive that something "locally-produced" also contributes to the local economy. Local source or origin might be an effective marketing attribute for wood or wood products made from local trees. Another study is examining willingness-to-pay among consumers for various types of wood products under different combinations of price, source, type of producer and land-ethic attributes. The "Connecticut-Grown" label and some indication of sustainable woodland management are attributes that rank high with consumers.

A survey of local secondary wood products manufacturers indicates that few are actively seeking to make use of locally produced wood. Raw material specifications for species, dimension and moisture content are most important to these wood customers. Reliability with respect to these attributes is an issue with small-scale producers. The quantities they seek are often too small for the high-production primary processors in CT. Networking and training program ideas are being explored. Another study underway is examining the collective capacity of portable bandsaw mills in CT. This study will explore whether operators are hobbyists or businesses, sources of raw materials, existing customer relationships and other issues.

At the UConn Forest, operational studies are underway using a variety of techniques, equipment and methods for small-scale harvesting and on-site primary processing. Time studies, material handling, local marketing techniques and other ideas are being tried and tested with the help of students and staff.

These efforts will help to determine the feasibility of wood utilization at the small-scale local level and the informational and educational needs for making local economic activity around local wood-use a reality.

UConn Professor Tom Worthley cutting a log to length for a portable bandsaw demonstration conducted by UConn and held at White Memorial for people interested in learning more about the opportunities associated with owning and running a portable sawmill.

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1 Article by Tom Worthley, Professor in Extension and Natural Resources and the Environment
2 For information of storm resilience and the roadside forest, see www.stormwise.info
3 Department of Natural Resources and the Environment: www.nrme.uconn.edu/
4 UConn Extension: www.extension.uconn.edu/

City Bench and Trees from Westport

In late 2013, Bruce Lindsay accepted the position of Tree Warden in Westport. One of his first assignments was to evaluate 11 tulip poplars and 4 Norway maples along a town road, adjacent to Longshore Club Park. The trees were huge – Bruce estimated them to be about 50-80 years old – and, in his determination, ready for removal. He knew that this would be a difficult decision for some in the town to accept, due to the size of the trees as well as their location. They were part of a well-liked and well-cared for row of trees leading into a popular town park. However, Bruce knew that his first duty as tree warden is to public safety and so he arranged for the removal of these trees.

Rather than simply disposing of these trees, Bruce saw this as an opportunity to continue the legacy of giving by these trees to the town. Bruce contacted Zeb and Ted Essylstyn of City Bench and asked if they would be interested in the wood. The two brothers quickly agreed.

City Bench, based in Higganum and New Haven, has as its tag line is "Furniture from the Urban Forest". It is a furniture making company with a vision that encompasses the full range of what urban trees can be. City Bench begins with the tree itself, with the idea that the trees that line our streets and are in our parks each have a story to tell. For some trees, part of that story is that tree's continued useful life as a piece of high quality furniture. The appreciation of the furniture is enhanced by an appreciation of the tree it is made of and what the tree contributed to all of us who dwell within the urban forest.

Ted and Zeb, and the others at City Bench, mill the wood from these trees themselves and then decide its use. Since each tree carries the tale of its unique history in its wood, the furniture made from these trees help people make that connection between their everyday lives and the natural world that exists at our doorsteps. It strengthens the understanding of our dependence upon, and our participation in, this natural world. Just as each piece of furniture has a use, each tree has a story. Tying the two together, using trees people know well, sets up a powerful message.

It is, in large part, a recycling message. City Bench is also, as Zeb puts it, about "turning waste streams into value streams". Over the years, City Bench has produced some 150,000 board feet from trees that grew in 29 Connecticut towns. They also got a few surprises. City Bench has found all sorts of items in trees, including metal bolts, concrete used to fill cavities, nails of all sorts, and more. These have cost the company more than a few bandsaw blades and has damaged numerous chainsaw chains, but City Bench continues on in business, accepting this loss in equipment as part of what happens when giving urban trees a second life.

City Bench continues to be very busy. Besides working with Westport, they have active projects with the City of New Haven, Yale University, the City of West Haven and additional private clients. More can be learned from their website at: www.city-bench.com.

Storm Damage and Urban Trees

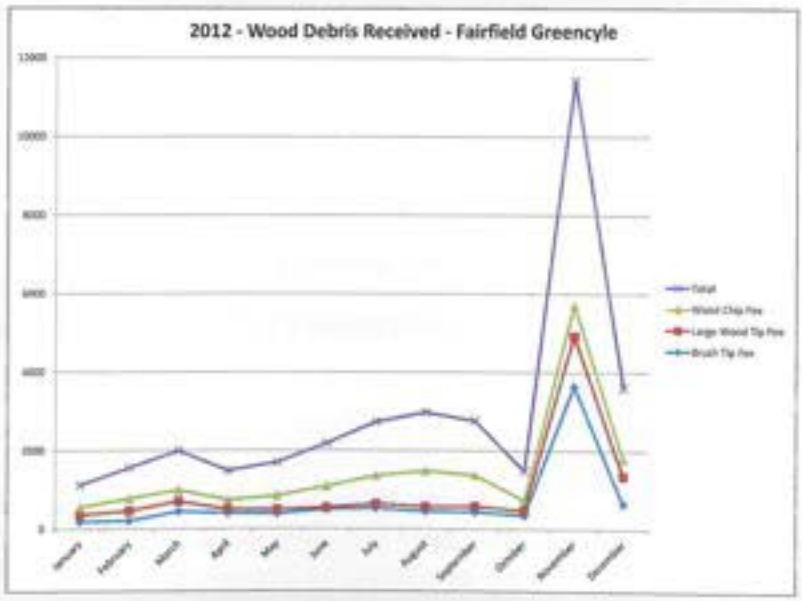
Much of the current discussion regarding urban forestry in Connecticut relates back to the major storms of recent memory – especially Tropical Storm Irene (August 2011), the October 2011 snowstorm and Tropical Storm Sandy (October 2012). Most often, this discussion centers around the disruptions caused by this storm, especially the damage done to the electrical power distribution system. Roadside trees of all sorts, including municipal and urban trees, were a major factor in this disruption.

Also significant in these storms is the amount of debris generated. In the aftermath of any major storm, whether local, state or region-wide, the downed trees and broken branches must be removed quickly and safely, to allow for immediate emergency access and initial response and then, as time moves along, to allow the recovery process to begin. Heavily damaged trees must also be removed, as part of the storm response and recovery effort.

All of this puts a large burden on the local storm response managers. In more widespread storms, the federal government will have a significant role, largely through the activities of FEMA, the Federal Emergency Management Agency. At the state level, emergency response activities are coordinated and led by the Governor, through the Department of Emergency Management and Homeland Security (DEMHS)[1]. Under the State Natural Disaster Plan, the Department of Energy and Environmental Protection has the responsibility for developing the framework for dealing with debris following a disaster, including woody debris. DEEP seeks to have a major role, both in terms of planning and in operational response, assisting local governments as they prepare for future storms[2].

If prior plans have been made, there are opportunities for those who use wood from urban and municipal trees to have a role in storm response and recovery. As is often said, the aftermath of a storm is not the time to be handing around business cards.

Harvest New England (then GreenCycle) in Fairfield played such as role following Tropical Storm Sandy. The mulch producer was able to absorb most of the woody debris generated in the Town of Fairfield. Just as importantly, they were able to work with FEMA inspectors, ensuring that Fairfield got a tally for the volume of woody debris generated. That was important in connection with the ability of the town to receive financial relief from the federal government following the storm.



1 www.ct.gov/demhs

2 See DEEP's web page on "Disaster Debris Management Preparedness": http://www.ct.gov/deep/cwp/view.asp?a=2718&Q=410492&deepNav_GID=1646

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Biomass Energy Resource Center, Montpelier, VT: www.biomasscenter.org

Dovetail Partners, Inc., St. Paul, MN: www.dovetailinc.org

Connecticut Department of Energy and Environmental Protection, Division of Forestry: www.ct.gov/deep/forestry

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